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DESCRIPTION

COMPRESSOR

Technical Field

The present invention relates to a hermetical rotational compressor used for a refrigerator-freezer, an air conditioner and the like.

Background of the Invention

Since a hermetical rotational compressor is compact in size and its structure is simple, the hermetical rotational compressor is widely used for a refrigerator-freezer, air conditioners and the like. Non-patent document, ["Air-Conditioning and Refrigeration handbook", new edition 5, volume II, machine", Air-Conditioning and Refrigeration Institute, 1993, paragraphs 30 to 43], describes structures of hermetical rotational compressors such as a rotary compressor and a scroll compressor. A structure of the conventional hermetical rotational compressor will be explained based on the rotary compressor and the scroll compressor with reference to Figs. 8 to 10.

Fig. 8 is a vertical sectional view of the conventional rotary compressor. The rotary compressor shown in the drawings comprises a container 1, a shaft 2 having an eccentric portion 2a, a cylinder 3, a roller 4, a vane 5, a spring 6, an upper bearing member 7 having a discharge hole 7a, a lower bearing member 8, a stator 11 having coil ends 11c and 11d projecting from upper and lower end surfaces 11a and 11b, respectively, and a rotor 12 fitted over the shaft 2.

In the above structure, a portion comprising the stator 11 and the rotor 12 is called a rotational motor, and a portion which forms a suction chamber and a compression chamber (not shown) in the cylinder 3 and which compresses a working fluid as the rotor 12 rotates is called a compression mechanism.

An outer periphery of the stator 11 is provided with a

plurality of notches 11e which function as passages of the working fluid. A gap 18 is provided between the stator 11 and the rotor 12. The container 1 is provided at its upper portion with an introduction terminal 13 for energizing the rotational motor from outside of the container 1, and a discharge pipe 15 for discharging the working fluid from the container 1 into a refrigeration cycle. The container 1 is provided at its side surface with a suction pipe 14 for introducing the working fluid from the refrigeration cycle into the compression mechanism. The container 1 is provided at its bottom with an oil reservoir 16 where refrigeration oil is reserved.

The operation of the rotary compressor having the above-described structure will be explained.

If the stator 11 is energized through the introduction terminal 13 to rotate the rotor 12, the roller 4 is eccentrically rotated by the eccentric portion 2a, and volumes of the suction chamber and the compression chamber are varied. With this, the working fluid is sucked into the suction chamber from the suction pipe 14 and is compressed in the compression chamber. The compressed working fluid supplied from the oil reservoir 16 is mixed with a refrigeration oil which lubricated the compression mechanism and, in this state, the working fluid is injected into a lower space 17 of the rotational motor through the discharge hole 7a.

The most of injected working fluid collides against a lower end surface 12a of the rotor 12 and then produces a strong turning flow by the rotation of the rotor 12. While the working fluid remains in the lower space 17 as a turning flow, a portion of the oil drops included in the working fluid attaches to an inner wall of the container 1 by a centrifugal force or drops downward due to gravity and returns into the oil reservoir 16.

In a state in which the working fluid includes the oil drops which are not separated, the most of working fluid passes through the notches 11e and the gap 18 from the lower space 17, and is injected toward an upper space 19 of the rotational motor. The injected working fluid flows toward the discharge

pipe 15 but at that time, a portion of the working fluid passes in the vicinity of an upper end surface 12b of the rotor 12, and produces the turning flow due to the rotation of the rotor 12. While the working fluid stays in the upper space 19, a portion of the oil drop included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force or drops downward due to the gravity and is separated, and returns into the oil reservoir 16 along the inner wall of the container 1 or a wall surface of the stator 11. The working fluid including the oil drops which are not yet separated is discharged from the discharge pipe 15.

Fig. 9 is a vertical sectional view of a conventional scroll compressor. The scroll compressor shown in Fig. 9 comprises a container 31, a shaft 32 having an eccentric portion 32a, a stationary scroll 33 having a spiral lap 33a and a discharge hole 33b, a moving scroll 34 having a spiral lap 34a and turning as the eccentric portion 32a eccentrically rotates, an upper bearing member 36 having the discharge hole 36c and supporting one end of the shaft 32, a stator 39 which has coil ends 39c and 39d projecting at right and left end surfaces 39a and 39b, respectively, and which is shrinkage fitted into the container 31, a rotor 40 shrinkage fitted over the shaft 32, and an auxiliary bearing member 41 supporting the other end of the shaft 32.

The lap 33a and the lap 34a are meshed with each other, and a plurality of suction chambers 37 and compression chambers 38 are formed in the stationary scroll 33 and the moving scroll 34. In the above structure, a structure comprising the stator 39 and the rotor 40 is called a rotational motor, and a structure which forms the suction chambers 37 and the compression chambers 38 and which compresses a working fluid as the rotational motor rotates is called a compression mechanism.

An outer periphery of the stator 39 is provided with a plurality of notches 39e which function as passages of the working fluid. A gap 48 is formed between the stator 39 and the rotor 40. The container 31 is provided with an

introduction terminal 42 for energizing the rotational motor from outside of the container 31. The container 31 is also provided with a suction pipe 43 for introducing the working fluid into the suction chambers 37 from the refrigeration cycle, and a discharge pipe 44 for discharging the working fluid into the refrigeration cycle from the container 31. Refrigeration oil is reserved in an oil reservoir 45 formed in a lower portion of the container 31, and the refrigeration oil is drawn up by an oil supply pump 46 from the oil reservoir 45, and is supplied to the compression mechanism.

The operation of the scroll compressor having the above-described structure will be explained.

If the stator 39 is energized through the introduction terminal 42 to rotate the rotor 40, the moving scroll 34 turns, and volumes of the suction chambers 37 and the compression chambers 38 are varied. With this, the working fluid is sucked from the suction pipe 43 into the suction chambers 37, and is compressed in the compression chambers 38. The compressed working fluid is supplied from the oil reservoir 45, and is mixed with oil drops of the refrigeration oil which lubricated a sliding surface of the compression mechanism and, in this state, the working fluid is injected into a right space 47 of the rotational motor through the discharge holes 33b and 36c.

The most of injected working fluid produces a turning flow by rotation of a right end surface 40a of the rotor 39. While the working fluid stays in the right space 47 as the turning flow, a portion of the oil drops included in the working fluid attach to the inner wall of the container 1 by the centrifugal force or drop due to the gravity, and is separated from the working fluid and returns into the oil reservoir 45.

In a state in which the working fluid includes oil drops which are not yet separated, the working fluid passes through the notches 39e or the gap 48 from the right space 47, and is injected into a left space 49 of the rotational motor. The most of injected working fluid flows toward the discharge pipe 44 but at that time, a portion of the working fluid passes in

the vicinity of a left end surface 40b of the rotor 40, and produces a turning flow due to rotation of the rotor 40. While the working fluid remains in the left space 49, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force or drops downward due to gravity and is separated and returns into the oil reservoir 45. The working fluid including the oil drops which are not yet separated is discharged from the discharge pipe 44.

In the hermetical type compressor such as the rotary compressor and the scroll compressor, in order to lubricate the sliding surface of the compression mechanism and to seal the gap, the compressed working fluid and refrigeration oil are mixed, a portion of the refrigeration oil reserved in the oil reservoir is discharged out from the container 1, 31 of the compressor in the course of operation of the compressor, but in the case of a compressor having a high amount of discharged refrigeration oil, since the oil level of the refrigeration oil in the oil reservoir 16, 45 is lowered, the supply oil amount becomes insufficient, and the lubrication of the compression mechanism becomes insufficient, the reliability is deteriorated, the sealing of the compression mechanism becomes insufficient, and the efficiency of the compressor is deteriorated. Further, the refrigeration oil discharged from the compressor attaches to an inner wall of a tube of a heat exchanger to deteriorate the heat transfer coefficient between the working fluid and a wall surface in the heat exchanger tube. Thus, the performance of the refrigeration cycle is deteriorated. Therefore, the oil separating efficiency of the working fluid in the container 1, 31 of the compressor is enhanced, and the discharging amount of the refrigeration oil is reduced.

As a structure for separating the refrigeration oil from the working fluid, there is a method to use an oil separating plate provided on an upper portion of the rotor 12 of the rotary compressor as shown in a patent document, [Japanese Patent

Application Laid-open No.H8-28476 (paragraph 6, Figs. 1 to 3)]. Fig. 10 shows a detailed sectional view of a periphery of the oil separating plate. The rotor 12 has an upper end plate 21a and a lower end plate 21b for closing inserting holes of a permanent magnet 20. A plurality of through holes 12c formed in the rotor 12 are provided to penetrate the rotor 12 in the vertical direction, and an oil separating plate 23 which is disposed above exits of the through holes 12c and which forms an oil separating space 22 between itself and an upper end surface of the rotor 12 are fixed to the rotor 12 by a fixing member 24.

According to the compressor having such a structure, a portion of the working fluid including oil drops discharged into the lower space 17 of the rotational motor from the compression mechanism flows into the oil separating space 22 through the through holes 12c formed in the rotor 12. The working fluid is radially discharged from the outer peripheral exit of the oil separating plate 23, and blows against the coil end 11d of the stator 11, and separates the refrigeration oil included in the working fluid. Only the working fluid from which the refrigeration oil is separated flows upward, and is discharged out from the discharge pipe 15 provided on the upper portion in the container 1. On the other hand, refrigeration oil attached to the coil end 11d of the stator 11 drops downward and returns into the oil reservoir 16 formed in the bottom of the container 1.

As described above, in the conventional rotary compressor, the most of working fluid injected into the lower space 17 of the rotational motor from the discharge hole 7a of the compression mechanism produces the strong turning flow by rotation of the rotor 12. The working fluid injected into the upper space 19 also produces the turning flow due to the rotation of the rotor 12. Similarly, the most of working fluid injected into the right space 47 and the left space 49 of the scroll compressor produces the turning flow due to the rotation of the rotor 40.

At that time, the oil drops of the refrigeration oil included in the working fluid are stirred by the turning flow and are finely divided. Since the turning flow in the lower space 17, the upper space 19, the right space 47 and the left space 49 increases the flow speed of the working fluid, the oil drops are prone to be transported by the working fluid. Therefore, it is difficult to completely separate the refrigeration oil from the working fluid by the separating method by means of the centrifugal force and gravity. Each of the lower end surface 12a and the upper end surface 12b of the rotor 12 is provided with a balancer 12d for overcoming the unbalance state of the roller 4 and the eccentric portion 2a of the shaft 2. Similarly, each of the right end surface 40a and the left end surface 40b of the rotor 40 is provided with a balancer 40c. In the case of a brushless DC motor, a bolt or a rivet (not shown) is provided for fixing a laminated steel plate and the magnet forming the rotor. As a result, the end surface of the rotor is formed with a large number of asperities, and the stirring of the working fluid is enhanced by rotating the asperities. Therefore, the oil drops of the refrigeration oil included in the working fluid are divided more finely, and it becomes difficult to separate the refrigeration oil from the working fluid.

As a method for separating the stirred and finely divided oil drops from the working fluid, the structure shown in Fig. 10 is used. In this case, however, with regard to the working fluid flowing from the lower space 17 toward the upper space 19 of the rotational motor, this method is effective only for the working fluid passing through the through holes 12c formed in the rotor 12, and it is impossible to separate the oil drops from the working fluid passing through the notches 11e of the stator 11 and the gap 18 between the stator 11 and the rotor 12. Further, the oil separating plate 23 is provided on the upper end surface 12b of the rotor. This structure promotes the stirring of the working fluid in the upper space 19 of the rotational motor, and there is a problem that it is more

difficult to separate the refrigeration oil in the upper space 19.

As another method, volumes of the lower space 17 and the upper space 19 of the rotational motor are increased, and a time during which the working fluid stays in such spaces is lengthened, and separation of the oil drop of the refrigeration oil is promoted by the gravity. However, in this case also, it is difficult to eliminate the influence of the stirring, and there is another problem that the compressor is increased in size.

The above description is based on the vertical type rotary compressor or the lateral type scroll compressor, but if the working fluid passes through an end surface of the rotor while a refrigerant discharged from the compression mechanism is discharged from the discharge pipe provided on the container, irrespective of a difference between the vertical type and the lateral type or irrespective of a difference of the compressing manners, the same problems mentioned above exist.

The above problems are generated irrespective of kinds of the working fluid which are used. However, the problems are particularly severe when the refrigeration cycle uses a working fluid mainly comprising carbon dioxide as a main ingredient, since the pressure of the working fluid discharged from the compression chamber exceeds a critical pressure, the working fluid in the container is brought into a supercritical state, and an amount of refrigeration oil solved in the working fluid is increased, thereby making it more difficult to separate the oil in the container.

The present invention has been accomplished to solve the above problems, and it is an object of the invention to provide a compressor capable of easily and inexpensively enhancing the oil separating efficiency without deteriorating the efficiency of the rotational motor, capable of reducing the amount of refrigeration oil to be removed from the container, and capable of enhancing the reliability of the compressor and obtaining an efficient refrigeration cycle.

As described above, according to the present invention, porous members are provided in the space between the rotational motor and the compression mechanism and the space between the rotational motor and the discharge pipe and the spaces are defined. Thus, the stirring phenomenon by turning flow caused due to rotation of the rotor and the stirring phenomenon caused by rotation of the asperities such as the balancer provided on the end surface of the rotor can be pushed into the space on the side of the rotational motor defined by the porous member so that the oil drops of the refrigeration oil mixed in the working fluid are prevented from being divided finely by the stirring phenomenon.

With this the effect that the oil drops falls due to the gravity and are separated is promoted, and the oil separating efficiency can be enhanced, and reliability and efficiency of the compressor and the refrigeration cycle using the compressor can be enhanced.

Summary of the Invention

A first aspect of the present invention provides a compressor comprising a compression mechanism for compressing working fluid, a rotational motor including a stator, a rotor for driving the compression mechanism and a container for accommodating the compression mechanism and the rotational motor, in which the compressed working fluid flows from the compression mechanism to the rotational motor, wherein a space between the compression mechanism and the rotational motor is defined by a porous member.

With this aspect, turning flow caused by rotation of the rotor is not generated in the working fluid in the space defined. Thus, oil drops caused by stirring effect of the turning flow are not finely divided, falling of the oil drops from the working fluid due to the gravity is promoted, and the oil separating effect can be enhanced.

A second aspect of the invention provides a compressor comprising a compression mechanism for compressing working

fluid, a rotational motor including a stator, a rotor for driving the compression mechanism and a container for accommodating the compression mechanism and the rotational motor, in which the container includes a discharge pipe on the opposite side of the compression mechanism with respect to the rotational motor, and the compressed working fluid flows from the rotational motor to the discharge pipe, wherein a space between the rotational motor and the discharge pipe is defined by a porous member.

With this aspect, turning flow caused by rotation of the rotor is not generated in the working fluid in the space defined. Thus, oil drops caused by stirring effect of the turning flow are not finely divided, falling of the oil drops from the working fluid due to the gravity is promoted, and the oil separating effect can be enhanced.

A third aspect of the invention provides a compressor comprising a compression mechanism for compressing working fluid, a rotational motor including a stator, a rotor for driving the compression mechanism and a container for accommodating the compression mechanism and the rotational motor, in which the container includes a discharge pipe on the opposite side of the compression mechanism with respect to the rotational motor, and the compressed working fluid flows from the compression mechanism to the discharge pipe through the rotational motor, wherein a space between the compression mechanism and the rotational motor is defined by one of porous members, and a space between the rotational motor and the discharge pipe is defined by the other porous member.

With this aspect, turning flow caused by rotation of the rotor is not generated in the working fluid in the space defined. Thus, oil drops caused by stirring effect of the turning flow are not finely divided, falling of the oil drops from the working fluid due to the gravity is promoted, and the oil separating effect can be enhanced.

According to a fourth aspect of the invention, in the compressor of any one of the first to third aspects, the porous

member is mounted on an element other than the rotor and a shaft fixed to the rotor.

With this aspect, since an element other than the rotor is not rotated, the porous member is not rotated either. Thus, it is possible to prevent the turning flow from being generated in the working fluid in the space defined by the porous member.

According to a fifth aspect of the invention, in the compressor of the fourth aspect, the compression mechanism includes a bearing member which supports the shaft, and the porous member is mounted on the bearing member.

With this aspect, the porous member is mounted on the bearing member which is the element other than the rotor, the turning flow is prevented from being generated, and a column for supporting the porous member is unnecessary, and the structure can be simplified.

According to a sixth aspect of the invention, in the compressor of the fifth aspect, the bearing member includes a projection provided on a side of the rotational motor, and the porous member is mounted on a groove formed in an outer peripheral surface of the projection.

With this aspect, since the porous member is mounted on the groove, the compressor can be assembled using no bolt, and the compressor can be produced inexpensively.

According to a seventh aspect of the invention, in the compressor of the fourth aspect, the porous member is mounted on an inner wall of the container.

With this aspect, since the porous member is mounted on the inner wall of the container which is an element other than the rotor, the turning flow is prevented from being generated, and the rotational motor and the compression mechanism can be used as they are without remaking the rotational motor and the compression mechanism.

According to an eighth aspect of the invention, in the compressor of the fourth aspect, the compression mechanism includes a bearing member which supports the shaft and an auxiliary bearing member which supports the shaft together

with the bearing member from both sides of the shaft on the opposite side from the bearing member with respect to the rotor.

With this aspect, since the porous member is mounted on the auxiliary bearing member which is an element other than the rotor, the turning flow is not generated, and the rotational motor can be used as it is without remaking the rotational motor.

According to a ninth aspect, in the compressor of any one of the first to third aspects, the porous member is made of porous material such as porous metal, porous resin and the like.

With this aspect, since the porous material has a wide surface area which comes into contact with the working fluid and the oil which pass through the porous member, the oil drops are prone to attach and grow, and the oil can be separated easily.

According to a tenth aspect, in the compressor of the ninth aspect, the porous member is formed into a plate-like shape.

With this aspect, since the surface of the plate is flat, disturbance of flow is not generated by the peel on the surface, and deterioration of the efficiency of the compressor caused by kinetic energy loss can be prevented.

According to an eleventh aspect, in the compressor of the ninth aspect, a central portion of the porous member is thicker than an outer periphery of the porous member.

With this aspect, the passage resistance of the outer periphery of the porous member becomes smaller than that of the central portion of the porous member, and since the working fluid is dispersed toward the outer periphery, the flow speed of the working fluid is reduced, and the oil separating effect is enhanced.

According to a twelfth aspect, in the compressor of any one of the first to third aspects, the porous member is made of mesh such as metal thin wire, glass wool, ceramic wool and the like.

With this aspect, since the mesh has a wide surface area which comes into contact with the working fluid and oil which pass through the mesh, the oil drops are prone to attach and grow, and the oil separating effect can further be enhanced.

According to a thirteenth aspect of the invention, in the compressor of the twelfth aspect, the mesh is enveloped by a plate member having an opening.

With this aspect, the plate member protects the mesh and prevents the mesh from being deformed and thus, the oil separating effect of the mesh can be maintained.

According to a fourteenth aspect of the invention, in the compressor of the twelfth aspect, a central portion of the mesh is higher density than that of an outer periphery of the mesh.

With this aspect, since the passage resistance of the outer periphery of the mesh is smaller than that of the central portion of the mesh, the working fluid is dispersed toward the outer periphery and thus, the flow speed of the working fluid is reduced and the oil separating effect is enhanced.

According to a fifteenth aspect, in the compressor of any one of the first to third aspects, the porous member is made of porous plate such as honeycomb, punching metal and the like.

With this aspect, since the passage resistances of an inlet, a hole wall and an outlet of each of the small holes of porous plate are high, the flow speed of the working fluid is largely reduced. Thus, the oil drops can easily be separated from the working fluid.

According to a sixteenth aspect of the invention, in the compressor of the fifteenth aspect, the porous plate comprises a plurality of porous plates laminated on one another.

With this aspect, since the porous plate comprises the plurality of porous plates laminated on one another, the passage resistance is further increased and thus, the flow speed of the working fluid is further reduced and the oil drops can be separated more effectively.

According to a seventeenth aspect of the invention, in the compressor of the fifteenth aspect, the porous plate has holes, and a diameter of a hole closer to a central portion of the porous plate is smaller than that of a hole closer to an outer periphery of the porous plate.

With this aspect, the passage resistance of the outer periphery of the porous plate becomes smaller than that of the central portion of the porous plate, the working fluid is dispersed toward the outer periphery, the flow speed of the working fluid is reduced and the oil separating effect is enhanced.

According to an eighteenth aspect, in the compressor of any one of the first to third aspects, the porous member is made of non-magnetic material.

With this aspect, if the porous member is made of non-magnetic material, the influence exerted on the magnetic circuit of the rotational motor is small, and the oil separating efficiency can be enhanced without deteriorating the efficiency of the rotational motor.

According to a nineteenth aspect, in the compressor of any one of the first to third aspects, the porous member is made of insulative material.

With this aspect, if the porous member is made of insulative material, it is unnecessary to take the electrical insulation performance into consideration, the porous member can be mounted in contact with the stator or the coil end, and a gap can be eliminated. If the gap is eliminated, the influence of the turning flow can be prevented, the stirring effect can be reduced, and the oil separating efficiency can be enhanced.

According to a twentieth aspect, in the compressor of any one of the first to third aspects, carbon dioxide is used as the working fluid.

With this aspect, carbon dioxide as an environment-friendly refrigerant can be used as the working fluid.

According to a twenty first aspect, in the compressor of any one of the first to third aspects, the compression mechanism is of a rotary type.

With this aspect, in a rotary compressor having a space in which working fluid comes into contact with a rotor end surface, the space is defined, the stirring effect caused by the turning flow of the working fluid in the defined space can be prevented more remarkably, and the oil separating effect can be enhanced.

According to a twenty second aspect, in the compressor of any one of the first to third aspects, the compression mechanism is of a scroll type.

With this aspect, in a scroll compressor, the stirring effect caused by the turning flow is prevented, and the oil separating effect can be enhanced.

Brief Description of the Drawings

Fig. 1 is a vertical sectional view of a rotary compressor according to a first embodiment of the present invention;

Fig. 2 is a lateral sectional view of the rotary compressor shown in Fig. 1 taken along the arrow Z-Z in Fig. 1;

Fig. 3 is a vertical sectional view of a rotary compressor according to a second embodiment of the invention;

Fig. 4 is a vertical sectional view of a rotary compressor according to a third embodiment of the invention;

Fig. 5 is a vertical sectional view of a rotary compressor according to a fourth embodiment of the invention;

Fig. 6 is a vertical sectional view of a rotary compressor according to a fifth embodiment of the invention;

Fig. 7 is a vertical sectional view of a scroll compressor according to a sixth embodiment of the invention;

Fig. 8 is a vertical sectional view of a conventional rotary compressor;

Fig. 9 is a vertical sectional view of a conventional scroll compressor; and

Fig. 10 is a detailed sectional view of a periphery of an oil separating plate of a conventional compressor.

Detailed Description

A compressor of a first embodiment of the present invention is a rotary compressor, and has a similar structure as that of the conventional rotary compressor explained using Fig. 8, and the same elements are designated with the same symbols.

Fig. 1 is a vertical sectional view of a rotary compressor according to the first embodiment of the invention, and Fig. 2 is a lateral sectional view of the rotary compressor shown in Fig. 1 taken along the arrow Z-Z in Fig. 1.

The rotary compressor shown in the drawings comprises a container 1, a compression mechanism disposed at a lower portion in the container 1, and a rotational motor disposed at an upper portion in the container 1. The compression mechanism includes a shaft 2 which can rotate around a center axis L, a cylinder 3, a roller 4 which is fitted over an eccentric portion 2a of the shaft 2 and which eccentrically rotates inside the cylinder 3 as the shaft 2 rotates, a vane 5 which reciprocates in a vane groove 3a of the cylinder 3 in a state in which a tip end of the vane 5 is in contact with the roller 4, a spring 6 for pushing the vane 5 against the roller 4, an upper bearing member 7 having a discharge hole 7a and a projection 7b and supporting the shaft 2 at an upper side of the cylinder 3, and a lower bearing member 8 supporting the shaft 2 at a lower side of the cylinder 3. A space between the cylinder 3 and the roller 4 sandwiched between the upper bearing member 7 and the lower bearing member 8 is divided by the vane 5 into a suction chamber 9 and a compression chamber 10.

The rotational motor includes a stator 11 which is shrinkage fitted into the container 1, and a rotor 12 which is shrinkage fitted over the shaft 2. The stator 11 is provided with a coil end 11c projecting from a lower end surface 11a

of the stator 11, and a coil end 11d projecting from an upper end surface 11b. The stator 11 is formed by laminating steel plates from its lower end surface 11a to its upper end surface 11b. The lower end surface 12a and the upper end surface 12b of the rotor 12 can be provided with balancers 12d if necessary. A porous member 51 is mounted on the upper bearing member 7 of the compression mechanism. The porous member 51 divides a space between the compression mechanism and the rotational motor into a lower compression mechanism-side space 17a and a lower rotational motor-side space 17b.

A plurality of notches 11e are provided between an outer peripheral side of the stator 11 and an inner wall of the container 1. The notches 11e function as passages for a working fluid. A gap 18 is provided between the stator 11 and the rotor 12. The container 1 is provided with an introduction terminal 13 for energizing the stator 11 from outside of the container 1, a suction pipe 14 for introducing the working fluid into the suction chamber 9 of the compression mechanism from the refrigeration cycle. The container 1 is provided with a discharge pipe 15 which discharges working fluid from the container 1 into the refrigeration cycle. The discharge pipe 15 is provided on the opposite sides from the compression mechanism with respect to the rotational motor. The refrigeration oil is reserved in an oil reservoir 16 formed in a bottom of the container 1.

As compared with the conventional rotary compressor shown in Fig. 8, the rotary compressor of this embodiment is characterized in that the porous member 51 is provided in the lower space 17 of the rotational motor. That is, the porous member 51 provided in the lower space 17 is made of porous material such as porous metal or porous resin. A peripheral edge of the porous member 51 is formed into a disk-like shape which comes into contact with an inner side surface of the container 1. The porous member 51 is provided at its central portion with a through hole into which an outer periphery of the projection 7b of the upper bearing member 7 can be fitted.

The through hole intersects with upper and lower end surfaces of the porous material. A lower end surface 51a of the porous member 51 projects downward in a convex manner. The porous member 51 is fitted over the projection 7b, the lower space 17 of the rotational motor is divided into the lower compression mechanism-side space 17a on the side of the compression mechanism and the lower rotational motor-side space 17b on the side of the rotational motor.

The operation of the rotary compressor having the above-described structure will be explained.

If the stator 11 is energized through the introduction terminal 13 to rotate the rotor 12, the roller 4 is eccentrically rotated by the eccentric portion 2a of the shaft 2, and volumes of the suction chamber 9 and the compression chamber 10 are varied. With this, the working fluid is drawn into the suction chamber 9 from the suction pipe 14, and is compressed in the compression chamber 10. The compressed working fluid is supplied from the oil reservoir 16, and lubricates a sliding surface of the compression mechanism, and is mixed with oil drops of refrigeration oil which seals the gap, and in this state, the working fluid is injected into the lower space 17 which is a flowing place of the working fluid between the compression mechanism and the rotational motor from the discharge hole 7a formed in the upper bearing member 7.

The working fluid which was injected into the lower space 17 stays in the lower compression mechanism-side space 17a which is defined by the porous member 51 and where the working fluid is not affected by rotation of the rotor 12. While the working fluid stays in the lower compression mechanism-side space 17a, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 or falls due to the gravity and is separated, and returns into the oil reservoir 16.

Thereafter, the working fluid passes through the porous member 51. At that time, since the flow speed of the working

fluid is reduced, the oil drops are separated from the working fluid in the porous member 51.

The working fluid which passed through the porous member 51 flows into the lower rotational motor-side space 17b, and causes the turning flow by the influence of rotation of the rotor 12, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16.

Further, working fluid which includes oil drops which are not separated from the working fluid passes through notches 11e and gap 18 from the lower rotational motor-side space 17b, and flows into the upper space 19 of the rotational motor. The working fluid which flowed into the upper space 19 from the notches 11e flows toward the discharge pipe 15. At that time, a portion of the working fluid passes in the vicinity of the upper end surface 12b of the rotor 12, and causes the turning flow by the influence of the rotation of the rotor 12. Working fluid which flowed into the upper space 19 from the gap 18 also flows toward the discharge pipe 15. At that time the working fluid also causes the turning flow by the influence of the rotation of the rotor 12.

On the other hand, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow, or drops due to the gravity, and is separated from the working fluid, and returns to the oil reservoir 16 along the inner wall of the container 1 or a wall surface of the stator 11. The working fluid including oil drops which are not yet separated is discharged from the discharge pipe 15.

With such a structure, since the lower compression mechanism-side space 17a is separated from the lower rotational motor-side space 17b by the porous member 51, the turning flow caused in the lower rotational motor-side space 17b by the rotation of the rotor 12 is not transmitted to the

lower compression mechanism-side space 17a. Further, the porous member 51 is fixed to an element other than the rotor 12 and the shaft 2 and the porous member 51 does not rotate. Therefore, turning flow caused by the porous member 51 is not generated in the lower compression mechanism-side space 17a.

Therefore, according to the rotary compressor of the embodiment, the working fluid is compressed by the compression mechanism and is discharged into the lower compression mechanism-side space 17a from the discharge hole 7a of the upper bearing member 7. The flow speed of this working fluid is not increased by the turning flow, and the ability of the working fluid which transports the oil drops of the refrigeration oil is lowered as compared with the conventional compressor. Therefore, oil separation effect generated by the density difference between the working fluid and the refrigeration oil in the lower compression mechanism-side space 17a is promoted. Further, the oil drops of the refrigeration oil are prevented from being divided finely by the turning flow and thus, the oil separating effect by the density difference between the working fluid and refrigeration oil is further promoted, and the oil separating efficiency can be enhanced.

The working fluid passes through the porous member 51 and moves from the lower compression mechanism-side space 17a toward the lower rotational motor-side space 17b. At that time, since the passage resistance in the porous member 51 is large, the flow speed of the working fluid is further reduced. The lower end surface 51a of the porous member 51 projects downward in the convex manner, a thickness of the central portion of the disk-like shape of the porous member 51 is thick and a thickness of its peripheral portion is thin. Therefore, working fluid which is discharged from the discharge hole 7a of the upper bearing member 7 and which collides against the central portion of the disk-like shape of the porous member 51 is dispersed toward the periphery along the convex surface shape of the lower end surface 51a, and its flowing width is increased, and the flow speed of the working fluid passing

through the porous member 51 is further reduced. Since the central portion of the porous member 51 is thick, resistance of the working fluid passing through the central portion is greater than that of the working fluid passing through the periphery.

Therefore, of the working fluid which is discharged from the discharge hole 7a of the upper bearing member 7 and which collides against the central portion of the disk-like shape of the porous member 51, an amount of working fluid which passes through the porous member 51 at the time of collision is further reduced, and an amount of working fluid which is once dispersed in the lower compression mechanism-side space 17a and then passes through the porous member 51 is increased, and the flow speed of the working fluid which passes through the porous member 51 is further reduced. Since the flow speed of the working fluid in the porous member 51 is reduced, the ability of the working fluid for transporting the refrigeration oil is reduced, and fine oil drops which can not be separated from the working fluid in the lower compression mechanism-side space 17a are easily be separated by the density difference between the working fluid and the refrigeration oil when the fine oil drops pass through the porous member 51.

The porous member 51 has a wide surface area with which the working fluid and the refrigeration oil come into contact. Therefore, the oil drops of the refrigeration oil easily attach to the porous member 51 and are prone to grow, and the oil drops fall downward of the porous member 51 by the density difference and thus, the oil separating effect is promoted.

As described above, since the porous member 51 is provided, the oil separating effect in the lower compression mechanism-side space 17a is promoted, and working fluid from which oil drops are largely separated flows into the lower rotational motor-side space 17b where stirring effect is generated by the turning flow and the rotation of the asperities such as the balancer 12d of the lower end surface 12a of the rotor 12. Thus, it is possible to minimize the possibility

that the oil separating effect becomes difficult due to the turning flow and the stirring effect in the lower rotational motor-side space 17b, and the mass of the refrigeration oil included in the working fluid discharged from the discharge pipe 15 is reduced.

Since the porous member 51 is fitted over the projection 7b of the upper bearing member 7, the constituent parts of the conventional rotary compressor can be used as they are, and the compressor can be produced inexpensively. Since the porous member 51 is fixed to the upper bearing member 7 which supports the shaft 2, it is easy to position the porous member 51 in the direction along the center axis L in the space between the rotational motor and the compression mechanism, and especially since the positioning member such as a spacer is unnecessary, the compressor can be produced inexpensively.

The space is defined by the porous member 51 made of porous metal or porous resin, the lower end surface 51a of the porous member 51 projects downward in the convex manner, the porous member 51 is provided at its central portion with the through hole into which the projection 7b can be fitted, the periphery of the porous member 51 can be precisely formed into the shape which agrees to the inner side surface of the container 1 and thus, the oil separating effect can be exhibited at full stretch.

The porous member 51 is of plate-like in shape, and the upper end surface 51b of the porous member 51 which comes into contact with the turning flow generated by the rotation of the rotor 12 in the lower rotational motor-side space 17b is flat. Therefore, turbulence caused by peel of the turning flow is not easily generated on the surface of the porous member 51. Thus, the efficiency of the compressor is not deteriorated by loss of kinetic energy caused by turbulent flow.

If the porous member 51 is made of non-magnetic material, influence on a magnetic circuit of the rotational motor is small, and the oil separating efficiency can be enhanced without deteriorating the efficiency of the rotational motor.

Since the porous member 51 is made of insulative material such as resin and ceramic, the porous member 51 can be disposed in contact with the coil end 11c of the stator 11. Therefore, it is unnecessary to provide a gap between the coil end 11c and the porous member 51 to take the electrical insulation performance into consideration. Therefore, it is unnecessary to increase the compressor in size so as to secure the gap between the coil end 11c and the porous member 51, and the embodiment can be realized in the container 1 having the same size as that of the conventional container.

It is preferable that the surface of the porous member 51 is lipophobic. If the surface of the porous member 51 is lipophobic, the refrigeration oil is not easily held on the surface of the porous member 51. Thus, the refrigeration oil attaches the porous member 51 and a particle diameter of the refrigeration oil is increased, and the refrigeration oil is prone to fall downward of the porous member 51 by the density difference. Therefore, refrigeration oil separated from the working fluid can easily return to the oil reservoir 16.

The vertical rotary compressor is explained in this embodiment, but if most of working fluid discharged from the compression mechanism passes in the vicinity of the rotor 12 until the working fluid is discharged from the discharge pipe 15 provided in the container 1 irrespective of the difference between the vertical type and the lateral type, or irrespective of the difference of compressing manners, the same effect can be obtained.

In a compressor in which the working fluid injected from the discharge hole 7a collides directly against the lower end surface 12a of the rotor 12 like the conventional rotary compressor, if the lower space 17 is defined by the porous member 51, the oil separating effect is exhibited more remarkably.

(Second Embodiment)

A compressor of a second embodiment of the present invention is similar to the rotary compressor of the first

embodiment explained using Fig. 1 and the conventional rotary compressor explained using Fig. 8. The same elements are designated with the same symbols. Explanation of the same structure and the same operation will be omitted.

Fig. 3 is a vertical sectional view of a rotary compressor according to the second embodiment of the invention.

The rotary compressor of the second embodiment is different from the conventional rotary compressor shown in Fig. 8 in that the porous member 52 is provided in the lower space 17 of the rotational motor. That is, the porous member 52 provided in the lower space 17 is made of porous material such as porous metal and porous resin. The porous member 52 has an upper end surface 52b from which a projection 52c projects upward. A periphery of the porous member 52 is formed into a disk-like shape which is in contact with an inner side surface of the container 1. The porous member 52 is formed at its central portion with a through hole. An outer periphery of the projection 7b of the upper bearing member 7 can be fitted into the through hole, and the through hole intersects with upper and lower end surfaces made of porous material. The porous member 52 is fitted over the projection 7b such that the lower end surface 52a and the upper bearing member 7 comes into tight contact with each other, and the porous member 52 defines the lower space 17 of the rotational motor and the compression mechanism from each other.

Further, the projection 52c of the upper end surface 52b of the porous member 52 is cylindrical in shape, and an outer diameter of the projection 52c is slightly smaller than an inner diameter of the inner side surface of the coil end 11c, and a small gap is provided so that the projection 52c does not come into contact with the lower end surface 12a of the rotor 12 and a balancer weight 12d. The periphery of the porous member 52 is in contact with the inner side surface of the container 1.

The operation of the rotary compressor having the above-described structure will be explained based on the flow

of the working fluid and the oil.

Working fluid which was compressed by the compression mechanism and injected into the lower space 17 from the discharge hole 7a directly flows into the porous member 52 because the lower end surface 52a of the porous member 52 is in tight contact with the upper bearing member 7. At that time, since the flow speed of the working fluid is reduced by the passage resistance in the porous member 52, oil drops included in the working fluid are separated from the working fluid in the porous member 52 and returns into the oil reservoir 16.

The working fluid which passed through the porous member 52 flows into the lower space 17. Since the projection 52c of the porous member 52 is accommodated inside the coil end 11c, the turning flow of the working fluid becomes weak by the influence of the rotation of the rotor 12. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16 along the inner wall of the container 1.

Thereafter, the working fluid passes through the notches 11e or gap 18 from the lower space 17 and flows into the upper space 19. Working fluid which flowed into the upper space 19 from the notches 11e flows toward the discharge pipe 15. At that time, a portion of the working fluid passes in the vicinity of the upper end surface 12b of the rotor 12 and causes turning flow by the influence of the rotation of the rotor 12. Working fluid which flowed into the upper space 19 through the gap 18 also flows toward the discharge pipe 15. At that time, the working fluid causes the turning flow by the influence of the rotation of the rotor 12.

On the other hand, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and are separated from the working fluid and returns into the oil reservoir 16. The working fluid is

discharged from the discharge pipe 15.

With the above structure, turning flow generated in the lower space 17 by the rotation of the rotor 12 is not transmitted to the porous member 52. Further, the porous member 52 is fixed to an element other than the rotor 12 and the shaft 2 and the porous member 52 does not rotate. Therefore, turning flow caused by the porous member 52 is not generated.

Therefore, according to the rotary compressor of the embodiment, the working fluid is compressed by the compression mechanism and discharged into the porous member 52 from the discharge hole 7a of the upper bearing member 7 through the lower end surface 52a. The flow speed of the working fluid is not increased by the turning flow, and ability of the working fluid to transport the oil drops of the refrigeration oil is lowered as compared with the conventional compressor. Thus, the oil separating effect by the density difference between the working fluid and refrigeration oil in the porous member 52 is enhanced. Since the oil drops of the refrigeration oil are not divided finely by the turning flow, the oil separating effect by the density difference between the working fluid and the refrigeration oil is further enhanced.

The working fluid passes through the porous member 52 and moves into the lower space 17. At that time, since the passage resistance in the porous member 52 is high, the flow speed of the working fluid is largely reduced. The thickness of the central portion of the porous member 52 is increased due to the projection 52c, the resistance of the working fluid when it passes through the central portion is greater than that of the working fluid passing through the periphery. Therefore, the working fluid discharged to the central area of the porous member 52 is dispersed from the central portion toward the periphery, and flows toward the lower space 17 and thus, the flow speed of the working fluid passing through the porous member 52 is further reduced. Since the flow speed of the working fluid in the porous member 52 is reduced, the ability of the working fluid to transport the refrigeration oil is

reduced, the oil separating effect by the density difference between the working fluid and the refrigeration oil is enhanced and thus, refrigeration oil included in the working fluid discharged from the discharge hole 7a of the upper bearing member 7 is separated from the working fluid in the porous member 52.

The porous member 52 has a wide surface area which comes into contact with the working fluid and the refrigeration oil passing through the porous member 52. Thus, the oil drops of the refrigeration oil are prone to attach to the porous member 52 and grow, and since the oil drops falls downward of the porous member 52 by the density difference, the oil separating effect is enhanced.

As described above, since the porous member 52 is disposed, the oil separating effect in the porous member 52 is enhanced, working fluid from which most of the oil drops are separated flows into the lower space 17 where stirring effect is generated by the turning flow and the rotation of the asperities such as the balancer weight 12d of the lower end surface 12a of the rotor 12. Thus, it is possible to minimize the possibility that the oil separating effect becomes difficult due to the turning flow and the stirring effect in the lower space 17, and the mass of the refrigeration oil included in the working fluid discharged from the discharge pipe 15 is reduced.

The second embodiment is different from the first embodiment in that the directions of the porous members 51 and 52 are different on the side of the lower end surface 51a and on the side of the upper end surface 52b, and in the second embodiment, the lower end surface 52a is in tight contact with the upper bearing member 7, the porous member 52 is fitted over the projection 7b of the upper bearing member 7, the porous member 52 made of porous metal or porous resin defines the space, the porous member 52 is of the plate-like shape, the porous member 52 is made of a non-magnetic material, the porous member 52 is made of insulative material such as resin and ceramic,

and the surface of the porous member 52 is lipophobic, and the same effects as those of the first embodiment can be obtained.
(Third Embodiment)

A compressor of a third embodiment of the present invention is similar to the rotary compressor of the first embodiment explained using Fig. 1. The same elements are designated with the same symbols. Explanation of the same structure and operation will be omitted.

Fig. 4 is a vertical sectional view of the rotary compressor according to the third embodiment of the invention.

The rotary compressor of this embodiment is different from the conventional rotary compressor shown in Fig. 8 in that a porous member 53 is provided in the lower space 17 of the rotational motor. That is, a mesh made of metal thin wire, glass wool, ceramic wool or the like is used as the porous member 53 provided in the lower space 17. Two annular ring grooves 7c and 7d are provided on the outer periphery of the projection 7b of the upper bearing member 7, the plate members 53a and 53b are provided at their central portions with through holes which can be fitted to the ring grooves 7c and 7d, and the plate members 53a and 53b are fitted and fixed to the ring grooves 7c and 7d. The plate members 53a and 53b pinch and fix the porous member 53, and the lower space 17 of the rotational motor is defined into the lower compression mechanism-side space 17a on the side of the compression mechanism and the lower rotational motor-side space 17b on the side of the rotational motor.

The plate members 53a and 53b are disk-like in shape made of resin or ceramic. The plate members 53a and 53b have a plurality of openings 53c and 53d in addition to the through hole formed in the central portions. The density of the porous member 53 is increased toward its central portion, and is pinched between the plate members 53a and 53b. The porous member 53 may have a combination of mesh and plate members 53a and 53b.

The operation of the rotary compressor having the

above-described structure will be explained based on the flow of the working fluid and the oil.

The working fluid which is compressed by the compression mechanism and injected from the discharge hole 7a into the lower space 17 is first stays in the lower compression mechanism-side space 17a defined by the porous member 53 and where the working fluid is not affected by the rotation of the rotor 12. While the working fluid stays in the lower compression mechanism-side space 17a, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 or falls due to the gravity downward and is separated from the working fluid and returns into the oil reservoir 16.

Then, the working fluid passes through the porous member 53. At that time, since the flow speed of the working fluid is reduced, the oil drops are separated from the working fluid in the porous member 53.

The working fluid which passed through the porous member 53 flows into the lower rotational motor-side space 17b, and generates the turning flow due to influence of the rotation of the rotor 12. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16.

Further, the working fluid passes through the notches 11e and the gap 18 from the lower rotational motor-side space 17b, and flows into the upper space 19 of the rotational motor. Working fluid which flowed into the upper space 19 from the notches 11e flows toward the discharge pipe 15. At that time, a portion of the working fluid passes in the vicinity of the upper end surface 12b of the rotor 12 and causes turning flow by the influence of the rotation of the rotor 12. Working fluid which flowed into the upper space 19 through the gap 18 also flows toward the discharge pipe 15. At that time, the working fluid causes the turning flow by the influence of the rotation of the rotor 12.

A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16 along the inner wall of the container 1 or the wall surface of the stator 11. Then, the working fluid is discharged from the discharge pipe 15.

With the above structure, since the lower compression mechanism-side space 17a is defined from the lower rotational motor-side space 17b by the plate members 53a and 53b and the porous member 53, the turning flow generated in the lower rotational motor-side space 17b by the rotation of the rotor 12 is not transmitted to the lower compression mechanism-side space 17a. The plate members 53a and 53b are fixed to elements other than the rotor 12 and the shaft 2 and are not rotated. Thus, the turning flow caused by the plate members 53a and 53b and the porous member 53 in the lower compression mechanism-side space 17a is not generated.

Therefore, according to the rotary compressor of the embodiment, the working fluid is compressed by the compression mechanism and discharged into the lower compression mechanism-side space 17a from the discharge hole 7a of the upper bearing member 7. The flow speed of the working fluid is not increased, and ability of the working fluid to transport the oil drops of the refrigeration oil is lowered as compared with the conventional compressor. Thus, the oil separating effect by the density difference between the working fluid and refrigeration oil in the lower compression mechanism-side space 17a is enhanced. Since the oil drops of the refrigeration oil are not divided finely by the turning flow, the oil separating effect by the density difference between the working fluid and the refrigeration oil is further enhanced.

The working fluid passes through the porous member 53 and moves from the lower compression mechanism-side space 17a to the lower rotational motor-side space 17b. At that time,

since the passage resistance in the porous member 53 is great, the flow speed of the working fluid is further reduced. The porous member 53 is pinched between the plate members 53a and 53b such that the density of the central portion of the porous member 53 is higher. Thus, the resistance of the working fluid passing through the central portion of the porous member 53 is higher than that of the working fluid passing through the periphery.

Therefore, of the working fluid which is discharged from the discharge hole 7a of the upper bearing member 7 and which collides against the central portion of the plate member 53a, an amount of working fluid which passes through the central portion of the plate member 53a is reduced, and an amount of working fluid which is once dispersed in the lower compression mechanism-side space 17a and then passes through the periphery of the plate member 53a is increased, and the flow speed of the working fluid which passes through the porous member 53 is further reduced. Thus, the flow speed of the working fluid in the porous member 53 is reduced, the ability of working fluid to transport the refrigeration oil is deteriorated, and when the fine oil drops which can not be separated from the working fluid in the lower compression mechanism-side space 17a pass through the porous member 53, the oil drops are easily separated from the working fluid by the density difference between the working fluid and the refrigeration oil.

The porous member 53 has a wide surface area which comes into contact with the working fluid and the refrigeration oil passing through the porous member 53. Thus, the oil drops of the refrigeration oil are prone to attach to the porous member 53 and grow, and since the oil drops falls downward of the porous member 53 and the plate member 53a by the density difference, the oil separating effect is enhanced.

As described above, since the plate members 53a and 53b and the porous member 53 are disposed, the oil separating effect in lower compression mechanism-side space 17a is enhanced, working fluid from which most of the oil drops are separated

flows into the lower rotational motor-side space 17b where stirring effect is generated by the turning flow and the rotation of the asperities such as the balancer weight 12d of the lower end surface 12a of the rotor 12. Thus, it is possible to minimize the possibility that the oil separating effect becomes difficult due to the turning flow and the stirring effect in the lower rotational motor-side space 17b, and the mass of the refrigeration oil included in the working fluid discharged from the discharge pipe 15 is reduced.

Further, the porous member 53 is pinched between the plate members 53a and 53b, the porous member 53 is not deformed by the flow of the working fluid and the porous member 53 is not deviated from the position when it is produced. Therefore, the refrigeration oil separating ability when the compressor is produced can be maintained. Since there is no fear that the compressor is not damaged by the contact with the rotational motor, the reliability is not deteriorated.

Since the plate members 53a and 53b are fixed to the upper bearing member 7 which supports the shaft 2, it is easy to position the porous member in the direction along the center axis L in the space between the rotational motor and the compression mechanism, and especially since the positioning member such as a spacer is unnecessary, the compressor can be produced inexpensively.

Since the plate members 53a and 53b are fitted and fixed to the ring grooves 7c and 7d, the compressor can be assembled without using fixing parts such as a bolt, and the compressor can be produced inexpensively.

Since the porous member 53 made of metal thin wire (i.e., metal mesh), glass wool, ceramic wool or the like defines the space, even if size in the radial direction between the outer peripheral surface of the projection 7b and the inner side surface of the container 1 is varied, the size variation can be absorbed and thus, the lower space 17 can easily be defined. It is easy to form the porous member 53 such that the central portion thereof has higher density.

The porous member 53 is of plate-like in shape, the surface of the plate member 53b which comes into contact with the turning flow generated in the lower rotational motor-side space 17b is flat. Therefore, turbulence caused by peel of the turning flow is not easily generated on the surface of the plate member 53b. Thus, the efficiency of the compressor is not deteriorated by loss of kinetic energy caused by turbulent flow.

If the plate members 53a and 53b and the porous member 53 are made of non-magnetic material, the influence acting on the magnetic circuit of the rotational motor is small, and the oil separating efficiency can be enhanced without deteriorating the efficiency of the rotational motor.

Since the plate members 53a and 53b and the porous member 53 are made of insulative material such as resin and ceramic, the plate member 53b can be disposed in contact with the coil end 11c of the stator 11. Thus, it is unnecessary to provide a gap between the coil end 11c and the plate member 53b to take the electrical insulation performance into consideration. Thus, it is unnecessary to increase the compressor in size so as to secure the gap between the coil end 11c and the porous member 53, and the embodiment can be realized in the container 1 having the same size as that of the conventional container.

It is preferable that the surface of the porous member 53 is lipophobic. If the surface of the porous member 53 is lipophobic, the refrigeration oil is not easily held on the surface of the porous member 53. Thus, the refrigeration oil attaches the porous member 53 and a particle diameter of the refrigeration oil is increased, and the refrigeration oil is prone to fall downward of the porous member 53 by the density difference. Therefore, refrigeration oil separated from the working fluid can easily return to the oil reservoir 16.

The vertical rotary compressor is explained in this embodiment, but if working fluid discharged from the compression mechanism passes in the vicinity of the rotor 12 until the working fluid is discharged from the discharge pipe

15 provided in the container 1 irrespective of the difference between the vertical type and the lateral type, or irrespective of the difference of compressing manners, the same effect can be obtained.

In a compressor in which the working fluid injected from the discharge hole 7a collides directly against the lower end surface 12a of the rotor 12 like the conventional rotary compressor, the effect for defining the lower space 17 by the porous member 53 is exhibited more remarkably.

(Fourth Embodiment)

A compressor of a fourth embodiment of the present invention is similar to the rotary compressor of the first embodiment and the conventional rotary compressor. The same elements are designated with the same symbols. Explanation of the same structure and operation will be omitted.

Fig. 5 is a vertical sectional view of a rotary compressor according to the fourth embodiment of the invention.

The rotary compressor of this embodiment is different from the conventional rotary compressor shown in Fig. 8 in that a porous member 54 is provided in the upper space 19 of the rotational motor. That is, a mesh made of metal thin wire, glass wool, ceramic wool or the like is used as the porous member 54 provided in the upper space 19. In the upper space 19 of the rotational motor, two plate members 54a and 54b are fixed to the inner side surface of the container 1 such that the plate members 54a and 54b become substantially vertical surfaces with respect to the center axial L. The plate members 54a and 54b pinch and fix the porous member 54 so that the upper space 19 of the rotational motor is defined into an upper rotational motor-side space 19a on the side of the rotational motor and an upper discharge pipe-side space 19b on the side of the discharge pipe 15.

The plate members 54a and 54b are of disk-like shape made of resin or ceramic, and include a plurality of openings 54c and 54d. The porous member 54 may have a combination of a mesh and the plate members 54a and 54b.

The operation of the rotary compressor having the above-described structure will be explained based on the flow of the working fluid and the oil.

Working fluid compressed by the compression mechanism and injected into the lower space 17 from the discharge hole 7a generates the turning flow by the influence of the rotation of the rotor 12. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16. Then, the working fluid passes through the notches 11e and the gap 18 from the lower space 17, and flows into the upper space 19 which is the flowing place of the working fluid between the rotational motor and the discharge pipe 15.

The working fluid which flowed into the upper space 19 generates the turning flow by the influence of the rotation of the rotor 12 in the upper rotational motor-side space 19a defined by the porous member 54. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16 along the inner wall of the container 1 or the wall surface of the stator 11.

Then, the working fluid passes through the porous member 54. At that time, since the flow speed of the working fluid is reduced, the oil drops are separated from the working fluid in the porous member 54.

The working fluid which passed through the porous member 54 flows into the upper discharge pipe-side space 19b defined by the porous member 54 and where the working fluid is not affected by the rotation of the rotor 12 and stays in the upper discharge pipe-side space 19b. While the working fluid stays in the upper discharge pipe-side space 19b, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 or falls due to the gravity and returns

into the oil reservoir 16 along the inner wall of the container 1. Then, the working fluid is discharged from the discharge pipe 15.

With the above structure, since the passage resistance in the porous member 54 is great, the turning flow generated in the upper rotational motor-side space 19a by the rotation of the rotor 12 does not affect the flow of the working fluid in the porous member 54 almost at all. Thus, the flow speed of the working fluid in the porous member 54 is reduced. The working fluid passes through the porous member 54 and moves from the upper rotational motor-side space 19a to the upper discharge pipe-side space 19b. At that time, since the passage resistance in the porous member 54 is great, the flow speed of the working fluid is largely reduced. For this reason, the flow speed of the working fluid in the porous member 54 is reduced and thus, the ability of the working fluid to transport the refrigeration oil is also reduced, and when the fine oil drops which could not be separated from the working fluid in the upper rotational motor-side space 19a are easily separated from the working fluid by the density difference between the working fluid and the refrigeration oil when the working fluid passes through the porous member 54.

The porous member 54 has a wide surface area which comes into contact with the working fluid and the refrigeration oil passing through the porous member 54. Thus, the oil drops of the refrigeration oil are prone to attach to the porous member 54 and grow, and since the oil drops falls downward of the porous member 54 and the plate member 54a by the density difference, the oil separating effect is enhanced.

Since the upper discharge pipe-side space 19b is defined from the upper rotational motor-side space 19a by the plate members 54a and 54b and the porous member 54, the turning flow generated in the upper rotational motor-side space 19a by the rotation of the rotor 12 is not transmitted to the upper discharge pipe-side space 19b. The plate members 54a and 54b are fixed to elements other than the rotor 12 and the shaft

2 and are not rotated. Thus, the turning flow caused by the plate members 54a and 54b and the porous member 54 in the upper discharge pipe-side space 19b is not generated.

Therefore, in the rotary compressor of the embodiment, the working fluid passes through the porous member 54a, the porous member 54 and the porous member 54b and flows into the upper discharge pipe-side space 19b. The flow speed of the working fluid is not increased by the turning flow, and the ability of the working fluid to transport the oil drops of the refrigeration oil is lowered as compared with the conventional compressor. Thus, the oil separating effect by the density difference between the working fluid and the refrigeration oil in the upper discharge pipe-side space 19b is enhanced. Further, since the oil drops of the refrigeration oil are not finely divided, the oil separating effect by the density difference between the working fluid and the refrigeration oil is further enhanced.

Oil drops are largely separated from the working fluid which passed through the plate members 54a and 54b and the porous member 54 from the upper rotational motor-side space 19a and flowed into the upper discharge pipe-side space 19b, and the turning flow is not transmitted to the upper discharge pipe-side space 19b. Thus, the oil separating effect is enhanced in the upper discharge pipe-side space 19b, and the mass of the refrigeration oil included in the working fluid discharged from the discharge pipe 15 is reduced.

Further, the porous member 54 is pinched between the plate members 54a and 54b, the porous member 54 is not deformed by the flow of the working fluid and the porous member 54 is not deviated from the position when it is produced. Therefore, the refrigeration oil separating ability when the compressor is produced can be maintained. Since there is no fear that the compressor is not damaged by the contact with the rotational motor, the reliability is not deteriorated.

Since the plate members 54a and 54b are fixed to the inner side surface of the container 1 it is easy to position the porous

member in the direction along the center axis L in the space between the rotational motor and the discharge pipe, and especially since the positioning member such as a spacer is unnecessary, the compressor can be produced inexpensively.

Since the porous member 54 made of metal thin wire, glass wool, ceramic wool or the like defines the space, even if inner diameter size of the container 1 is varied, the size variation can be absorbed and thus, the upper space 19 can easily be defined.

Since the porous member 54a is of plate-like shape, the surface of the plate member 54a which comes into contact with the turning flow generated in the upper rotational motor-side space 19a is flat. Therefore, turbulence caused by peel of the turning flow is not easily generated on the surface of the porous member 54a. Thus, the efficiency of the compressor is not deteriorated by loss of kinetic energy caused by turbulent flow.

If the plate members 54a and 54b and the porous member 54 are made of non-magnetic material, the influence acting on the magnetic circuit of the rotational motor is small, and the oil separating efficiency can be enhanced without deteriorating the efficiency of the rotational motor.

Since the plate members 54a and 54b are made of insulative material such as resin and ceramic and the porous member 54 is made of insulative glass wool, ceramic wool or the like, the plate member 54b can be disposed in contact with the coil end 11c of the stator 11. Thus, it is unnecessary to provide a gap between the coil end 11c and the plate member to take the electrical insulation performance into consideration. Thus, it is unnecessary to increase the compressor in size so as to secure the gap between the coil end 11c and the porous member, and the embodiment can be realized in the container 1 having the same size as that of the conventional container.

It is preferable that the surface of the porous member 54 is lipophobic. If the surface of the porous member 54 is lipophobic, the refrigeration oil is not easily held on the

surface of the porous member 54. Thus, the refrigeration oil attaches the porous member 54 and a particle diameter of the refrigeration oil is increased, and the refrigeration oil is prone to fall downward of the porous member 54 by the density difference. Therefore, refrigeration oil separated from the working fluid can easily return to the oil reservoir 16.

The vertical rotary compressor is explained in this embodiment, but if most of working fluid discharged from the compression mechanism passes in the vicinity of the rotor 12 until the working fluid is discharged from the discharge pipe 15 provided in the container 1 irrespective of the difference between the vertical type and the lateral type and irrespective of the difference of compressing manner, the same effect can be obtained.

(Fifth Embodiment)

A compressor of a fourth embodiment of the present invention is similar to the rotary compressor of the first embodiment and the conventional rotary compressor. The same elements are designated with the same symbols. Explanation of the same structure and operation will be omitted.

Fig. 6 is a vertical sectional view of the rotary compressor according to the fifth embodiment of the invention.

The rotary compressor of this embodiment is different from the conventional rotary compressor shown in Fig. 8 in that the lower space 17 and the upper space 19 of the rotational motor are provided with porous members 55 and 56, respectively. That is, disk-like porous plate 55a, 55b, 55c, 56a, 56b and 56c comprising honeycomb or punching metal made of resin or ceramic are used as the porous members 55 and 56 provided on the lower space 17 and the upper space 19. An outer periphery of the projection 7b of the upper bearing member 7 are provided with three annular ring groove 7e, 7f and 7g from a lower position of the outer periphery in this order. The disk-like porous plates 55a, 55b, 55c are provided at their central portions with through holes which can be fitted to the ring grooves. The porous plates 55a, 55b, 55c are fitted and fix

to the ring groove 7e, 7f and 7g. Of the porous members 55 and 56, the porous member 55 comprising the porous plates 55a, 55b, 55c defines the lower space 17 of the rotational motor into the lower compression mechanism-side space 17a on the side of the compression mechanism and the lower rotational motor-side space 17b on the side of the rotational motor.

In the upper space 19, the porous plates 56a, 56b and 56c are fixed to the inner side surface of the container 1 from a lower portion in the upper space 19 in this order, and the other porous member 56 comprising the porous plates 56a, 56b and 56c defines the upper space 19 of the rotational motor into the upper rotational motor-side space 19a on the side of the rotational motor and the upper discharge pipe-side space 19b on the side of the discharge pipe 15.

The porous plate 55a, 55b, 55c, 56a, 56b and 56c are disposed such that they are substantially perpendicular to the center axis L. The porous plate 55a, 55b, 55c, 56a, 56b and 56c has a plurality of small holes. The positions of the small holes are different among the respective porous plates. The small holes closer to the central portion have smaller diameters.

Although the porous member 55 comprises three porous plates 55a, 55b, 55c which are laminated on one another in this embodiment, the porous member 55 may comprise at least one porous plate 55a. Similarly, the porous member 56 may comprise the three porous plates 56a, 56b and 56c to one porous plate 56a. In the following explanation, the porous plates 55a, 55b, 55c may be called a porous member 55, and the porous plates 56a, 56b and 56c may be called a porous member 56.

The operation of the rotary compressor having the above-described structure will be explained based on the flow of the working fluid and the oil.

The working fluid which is compressed by the compression mechanism and injected from the discharge hole 7a into the lower space 17 first stays in the lower compression mechanism-side space 17a defined by the porous member 55 and where the working

fluid is not affected by the rotation of the rotor 12. While the working fluid stays in the lower compression mechanism-side space 17a, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 or falls due to the gravity downward and is separated from the working fluid and returns into the oil reservoir 16.

Thereafter, the working fluid passes through the porous member 55. At that time, the flow speed of the working fluid is reduced and thus, the oil drops are separated from the working fluid in the porous member 55. The working fluid which passed through the porous member 55 flows into the lower rotational motor-side space 17b and generates the turning flow by the influence of the rotation of the rotor 12. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16.

Further, the working fluid passes through the notches 11e and the gap 18 from the lower rotational motor-side space 17b, and flows into the upper space 19 of the rotational motor. The working fluid which flowed into the upper space 19 generates the turning flow by the influence of the rotation of the rotor 12 in the upper rotational motor-side space 19a defined by the porous member 56. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 16 along the inner wall of the container 1 or the wall surface of the stator 11.

Thereafter, the working fluid passes through the porous member 56. At that time, the flow speed of the working fluid is reduced and thus, the oil drops are separated from the working fluid in the porous member 56. The working fluid which passed through the porous member 56 flows into the upper discharge pipe-side space 19b defined by the porous member 56 and where the working fluid is not affected by the rotation

of the rotor 12 and stays. While the working fluid stays in the upper discharge pipe-side space 19b, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 1 or falls due to the gravity downward and is separated from the working fluid and returns into the oil reservoir 16 along the inner wall of the container 1 or the like. Then, the working fluid is discharged from the discharge pipe 15.

With the above structure, since the lower compression mechanism-side space 17a is defined from the lower rotational motor-side space 17b by the porous plates 55a, 55b, 55c, the turning flow generated in the lower rotational motor-side space 17b by the rotation of the rotor 12 is not transmitted to the lower compression mechanism-side space 17a. Further, the porous plates 55a, 55b, 55c are fixed to elements other than the rotor 12 and the shaft 2 and are not rotated. Thus, the turning flow caused by the porous plates 55a, 55b, 55c in the lower compression mechanism-side space 17a is not generated.

Therefore, in the rotary compressor of the embodiment, the flow speed of the working fluid compressed in the compression mechanism and discharged from the discharge hole 7a of the upper bearing member 7 into the lower compression mechanism-side space 17a is not increased by the turning flow, and the ability of the working fluid to transport the oil drops of the refrigeration oil is lowered as compared with the conventional compressor. Thus, the oil separating effect by the density difference between the working fluid and the refrigeration oil in the lower compression mechanism-side space 17a is enhanced. Further, since the oil drops of the refrigeration oil are not finely divided by the turning flow, the oil separating effect by the density difference between the working fluid and the refrigeration oil is further enhanced.

The working fluid passes through the porous plates 55a, 55b, 55c and moves from the lower compression mechanism-side

space 17a to the lower rotational motor-side space 17b. At that time, since the passage resistances at the inlets, hole walls and outlets of the small holes of the porous plates 55a, 55b, 55c are high, the flow speed of the working fluid is further reduced. Since the diameters of the small holes of the porous plates 55a, 55b, 55c closer to the central portions of the plates are smaller, resistance of the working fluid passing through the central portion is greater than that of the working fluid passing through the periphery.

Thus, of the working fluid which is discharged from the discharge hole 7a of the upper bearing member 7 and collides against the central area of the porous plate 55a, an amount of working fluid passing through the small holes of the central portions of the porous plate 55a is reduced, an amount of working fluid which is once dispersed in the lower compression mechanism-side space 17a and passes through the small holes of the peripheries of the porous plates 55a, 55b, 55c is increased, and the flow speed of the working fluid passing through the porous plates 55a, 55b, 55c is further reduced. Therefore, the speed of the working fluid in the porous plates 55a, 55b, 55c is reduced and the ability of the working fluid to transport the refrigeration oil is reduced, and when the working fluid passes through the porous plates 55a, 55b, 55c, the fine oil drops which can not be separated from the working fluid in the lower compression mechanism-side space 17a are easily separated from the working fluid by the density difference between the working fluid and the refrigeration oil.

The porous plates 55a, 55b, 55c are provided with the plurality of small holes, and the positions of the small holes in the porous plates are different from each other. Therefore, the working fluid and refrigeration oil passing through the small holes of the porous plate 55a collide against the porous plate 55b, working fluid and refrigeration oil passing through the small holes of the porous plate 55b collide against the porous plate 55c. Thus, the working fluid and refrigeration

oil easily come into contact with the surface of the porous plate. Hence, the oil drops of the refrigeration oil attach to the porous plates 55a, 55b, 55c and grow and fall downward of the porous plate 55a, and the oil separating effect is enhanced.

As described above, since the porous plates 55a, 55b, 55c are provided, the oil separating effect in the lower compression mechanism-side space 17a is enhanced, and working fluid from which most of oil drops are separated flows into the lower rotational motor-side space 17b where stirring effect is generated by the turning flow and rotation of the asperities such as the balancer weight 12d of the lower end surface 12a of the rotor 12. Thus, it is possible to minimize the possibility that the oil separating effect becomes difficult due to the turning flow and the stirring effect in the lower rotational motor-side space 17b, and the working fluid passes through the notches 11e of the stator 11 and the gap 18 between the stator 11 and the rotor 12 and is discharged into the upper rotational motor-side space 19a.

In the upper space 19, the porous plates 56a, 56b and 56c re fixed to the container 1 substantially perpendicularly to the center axis L. Turning flow generated by the rotation of the rotor 12 in the upper rotational motor-side space 19a is less prone to be transmitted beyond the porous plates 56a, 56b and 56c. The working fluid passes through the porous plates 56a, 56b, 56c and moves from the upper rotational motor-side space 19a to the upper discharge pipe-side space 19b. At that time, since the passage resistances at the inlets, hole walls and outlets of the small holes of the porous plates 56a, 56b, 56c are high, the flow speed of the working fluid is largely reduced in the porous plates 56a, 56b and 56c. Since the flow speed of the working fluid is reduced, the ability of the working fluid to transport the refrigeration oil is reduced, and when the working fluid passes through the porous plates 56a, 56b, 56c, the fine oil drops which can not be separated from the working fluid in the upper rotational

motor-side space 19a are easily separated from the working fluid by the density difference between the working fluid and the refrigeration oil.

The porous plates 56a, 56b, 56c are provided with the plurality of small holes, and the positions of the small holes in the porous plates are different from each other. Therefore, the working fluid and refrigeration oil passing through the small holes of the porous plate 56a collide against the porous plate 56b, working fluid and refrigeration oil passing through the small holes of the porous plate 56b collide against the porous plate 56c. Thus, the working fluid and refrigeration oil easily come into contact with the surface of the porous plate. Hence, the oil drops of the refrigeration oil attach to the porous plates 56a, 56b and 56c and grow and fall downward of the porous plate 56a, and the oil separating effect is enhanced.

Since the upper discharge pipe-side space 19b is defined from the upper rotational motor-side space 19a by the porous plates 56a, 56b, 56c, the turning flow generated in the upper rotational motor-side space 19a by the rotation of the rotor 12 is not transmitted to the upper discharge pipe-side space 19b. Further, the porous plates 56a, 56b, 56c are fixed to elements other than the rotor 12 and the shaft 2 and are not rotated. Thus, the turning flow caused by the porous plates 56a, 56b, 56c in the upper discharge pipe-side space 19b is not generated.

Therefore, according to the rotary compressor of this embodiment, the working fluid passes through the porous plates 56a, 56b and 56c and flows into the upper discharge pipe-side space 19b, the flow speed of the working fluid is not increased by the turning flow, and the ability of the working fluid to transport the oil drops of the refrigeration oil is reduced as compared with the conventional compressor. Thus, the oil separating effect by the density difference between the working fluid and the refrigeration oil in the upper discharge pipe-side space 19b is enhanced. Further, since the oil drops

of the refrigeration oil are not finely divided by the turning flow, the oil separating effect by the density difference between the working fluid and the refrigeration oil is further enhanced.

As described above, since the porous plates 56a, 56b, 56c are provided, most of oil drops are separated from working fluid which passes through the porous plates 56a, 56b and 56c and flows into the upper discharge pipe-side space 19b from the upper rotational motor-side space 19a where stirring effect is generated by the turning flow and the rotation of the asperities such as the balancer weight 12d of the rotor 12. The turning flow is not transmitted to the upper discharge pipe-side space 19b. Therefore, the oil separating effect in the upper discharge pipe-side space 19b is enhanced, and the mass of the refrigeration oil included in the working fluid discharged from the discharge pipe 15 is reduced.

Since the porous plates 55a, 55b, 55c are fixed to the upper bearing member 7 which supports the shaft 2, it is easy to position the porous plates in the direction along the center axis L in the space between the rotational motor and the discharge pipe, and especially since the positioning member such as a spacer is unnecessary, the compressor can be produced inexpensively. Similarly, since the porous plates 56a, 56b and 56c are fixed to the inner side surface of the container 1, it is easy to position the porous plates in the direction along the center axis L in the space between the rotational motor and the discharge pipe, and especially since the positioning member such as a spacer is unnecessary, the compressor can be produced inexpensively.

Since the porous plates 55a, 55b, 55c are fitted and fixed to the ring groove 7e, 7f and 7g, the compressor can be assembled without using fixing parts such as a bolt, and the compressor can be produced inexpensively.

Since the space is defined by the porous plates 55a, 55b, 55c and the porous plates 56a, 56b and 56c such as the honeycomb or the punching metal, the porous plates 55a, 55b, 55c can be

provided with the through holes which can be fitted to the projection 7b of the upper bearing member 7, and it is easy to form the porous plates 55a, 55b, 55c into the circular shape which can just accommodated in the inner side surface of the container 1 and thus, the compressor can be produced inexpensively.

Since the porous plate 55c and the porous plate 56a are of the plate-like shape, the surfaces of the porous plate 55c and the porous plate 56a which come into contact with the turning flow generated in the lower rotational motor-side space 17b and the upper rotational motor-side space 19a are flat. Therefore, turbulence caused by peel of the turning flow is not easily generated on the surfaces of the porous plate 55c and the porous plate 56a. Thus, the efficiency of the compressor is not deteriorated by loss of kinetic energy caused by turbulent flow.

If the porous plates 55a, 55b, 55c and the porous plates 56a, 56b and 56c are made of non-magnetic material, the influence acting on the magnetic circuit of the rotational motor is small, and the oil separating efficiency can be enhanced without deteriorating the efficiency of the rotational motor.

Since at least the porous plate 55c and the porous plate 56a which are opposed to the rotational motor are made of insulative material such as resin and ceramic, the porous plate 55c and the porous plate 56a can be disposed in contact with the coil end 11c and the coil end 11d of the stator 11. Thus, it is unnecessary to provide a gap between the coil end 11c and the coil end 11d to take the electrical insulation performance into consideration. Thus, it is unnecessary to increase the compressor in size so as to secure the gap between the coil end 11c and the coil end 11d, and the embodiment can be realized in the container 1 having the same size as that of the conventional container.

It is preferable that the surface of the porous plate 55 is lipophobic. If the surface of the porous plate 55 is

lipophobic, the refrigeration oil is not easily held on the surface of the porous plate 55. Thus, the refrigeration oil attaches the porous plate 55 and a particle diameter of the refrigeration oil is increased, and the refrigeration oil is prone to fall downward of the porous plate 55 by the density difference. Therefore, refrigeration oil separated from the working fluid can easily return to the oil reservoir 16.

The vertical rotary compressor is explained in this embodiment, but if most of working fluid discharged from the compression mechanism passes in the vicinity of the rotor 12 until the working fluid is discharged from the discharge pipe 15 provided in the container 1 irrespective of the difference between the vertical type and the lateral type, or irrespective of the difference of compressing manners, the same effect can be obtained.

In a compressor in which the working fluid injected from the discharge hole 7a collides directly against the lower end surface 12a of the rotor 12 like the conventional rotary compressor, the effect for defining the lower space 17 or the upper space 19 by the porous member 55 or the porous member 56 is exhibited more remarkably.

(Sixth Embodiment)

A compressor of a sixth embodiment of the present invention is a scroll compressor, and is similar to the conventional scroll compressor explained using Fig. 9. The same elements are designated with the same symbols. Explanation of the same structure and operation will be omitted.

Fig. 7 is a vertical sectional view of the scroll compressor according to the sixth embodiment of the invention.

The illustrated scroll compressor comprises a container 31, a compression mechanism disposed on the right side in the container 31 and a rotational motor disposed on the left side in the container 31. The compression mechanism can rotate around the center axis L. The compression mechanism includes a shaft 32 having an eccentric portion 32a, a stationary scroll

33 having a spiral lap 33a such as an involute and a discharge hole 33b, a moving scroll 34, an Oldham ring 35 which prevents the moving scroll 34 from rotating, and a bearing member 36 having a discharge hole 36a and a projection 36b. The moving scroll 34 is opposed to the stationary scroll 33, and has a spiral lap 34a. The moving scroll 34 is disposed such that the laps 33a and 34a mesh with each other. The moving scroll 34 turns as the eccentric portion 32a eccentrically rotates. The bearing member 36 supports the shaft 32. A plurality of suction chambers 37 and compression chambers 38 are formed between the stationary scroll 33 and the moving scroll 34.

The rotational motor includes a stator 39 which is shrinkage fitted into the container 31 and a rotor 40 which is shrinkage fitted over the shaft 32. The stator 39 is provided with a coil end 39c projecting from a right end surface 39a of the stator 39, and a coil end 39d projecting a left end surface 39b of the stator 39. The stator 39 comprises laminated steel plates from its right end surface 39a to its left end surface 39b. A right end surface 40a and a left end surface 40b of the rotor 40 can be provided with balancers 40c if necessary.

Porous plates 57a, 57b and 57c are mounted to the projection 36b of the bearing member 36. The porous plates 57a, 57b and 57c define a right space 47 between the rotational motor and the compression mechanism into a right compression mechanism-side space 47a and a right rotational motor-side space 47b. An auxiliary bearing member 41 is disposed on the left side of the rotational motor on the opposite side from the bearing member 36 with respect to the rotor 40. The auxiliary bearing member 41 supports the shaft 32. Porous plates 58a, 58b and 58c are mounted to a projection 41a of the auxiliary bearing member 41 for defining a left space 49 between the rotational motor and a discharge pipe 44 into a right rotational motor-side space 49a and a left discharge pipe-side space 49b.

A plurality of notches 39e function as passages of the

working fluid is provided between the outer periphery of the stator 39 and the inner wall of the container 31. A gap 48 is provided between the stator 39 and the rotor 40. The projection 36b is provided with ring grooves 36c, 36d and 36e, and the projection 41a is provided with ring grooves 41b, 41c and 41d.

The container 31 is provided at its wall with an introduction terminal 42 for energizing the stator 39 outside of the container 31, a suction pipe 43 for introducing working fluid from the refrigeration cycle to a suction chambers 37, and a discharge pipe 44 for discharging the working fluid into the refrigeration cycle from the container 31. Refrigeration oil is reserved in an oil reservoir 45 formed in a bottom of the container 31. The refrigeration oil is pumped up from the oil reservoir 45 by a lubrication pump 46 to supply the refrigeration oil into the compression mechanism through an oil-supply hole (not shown) of the shaft 32.

As compared with the conventional scroll compressor shown in Fig. 9, the scroll compressor of this embodiment is characterized in that one of the porous members 57 comprising the porous plates 57a, 57b and 57c are provided in the right space 47 of the rotational motor, and the other porous member 58 comprising the porous plates 58a, 58b and 58c is provided in the left space 49 of the rotational motor. That is, the disk-like porous plates 57a, 57b and 57c and porous plates 58a, 58b and 58c comprising honeycomb or punching metal made of resin or ceramic are used as the porous members 57 and 58 provided in the right space 47 and the left space 49, respectively.

The outer periphery of the projection 36b of the bearing member 36 is provided with the three annular ring grooves 36c, 36d and 36e from the right in this order. The porous plates 57a, 57b and 57c are provided at their central portions with the through holes which can be fitted to the ring grooves. The porous plates 57a, 57b and 57c are fitted and fixed to the ring grooves 36c, 36d and 36e, and the right space 47 of the rotational motor is defined into a right compression

mechanism-side space 47a on the side of the compression mechanism and a right rotational motor-side space 47b on the side of the rotational motor.

The auxiliary bearing member 41 is provided with the projection 41a which projects to a portion near the left end surface 40b of the rotor 40. The outer periphery of the projection 41a of the auxiliary bearing member 41 is provided with the three annular ring grooves 41c, 41d and 41e from the right to the left in this order. The porous plates 58a, 58b and 58c are provided at their central portions with through holes which can be fitted to the ring grooves. The porous plates 58a, 58b and 58c are fitted and fixed to the ring grooves 41c, 41d and 41e, and the left space 49 of the rotational motor is defined into a left rotational motor-side space 49a on the side of the rotational motor and a left discharge pipe-side space 49b on the side of the discharge pipe 42.

The porous plates 57a, 57b, 57c, 58a, 58b and 58c are substantially perpendicular to the center axis L. The porous plates 57a, 57b, 57c, 58a, 58b and 58c has a plurality of small holes, and the positions of the small holes in the porous plates are different from each other. The small hole closer to the central portion has a smaller diameter.

Although the porous member 57 comprises three porous plates 57a, 57b and 57c laminated on one another in this embodiment, the porous member 57 may comprises at least one porous plate 57a. Similarly, the porous member 58 may comprise the three porous plates 58a, 58b and 58c to one porous plate 58a. At least one of the porous member 57 and porous member 58 may be provided. In the following explanation, the porous plates 57a, 57b and 57c may be called as the porous member 57, and the porous plates 58a, 58b and 58c may be called as the porous member 58.

The operation of the scroll compressor having the above structure will be explained.

If the stator 39 is energized through the introduction terminal 42 to rotate the rotor 40, the moving scroll 34 turns,

and volumes of the suction chambers 37 and the compression chambers 38 formed between the laps 33a and 34a of the stationary scroll 33 and the moving scroll 34 are varied. With this, working fluid is sucked into the suction chambers 37 from the suction pipe 43, and is compressed in the compression chambers 38. The compressed working fluid is supplied from the oil reservoir 45 to lubricate the sliding surface of the compression mechanism, and in a state in which the oil drops of refrigeration oil which seal the gap are mixed into the working fluid, the working fluid is injected into the right space 47 which is a flowing place of the working fluid between the compression mechanism and the rotational motor through the discharge holes 33b and 36a.

The working fluid injected into the right space 47 stays in the right compression mechanism-side space 47a defined by the porous member 57 and where the working fluid is not influence by the rotation of the rotor 12. While the working fluid stays in the right compression mechanism-side space 47a, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 31 or falls downward due to the gravity and is separated from the working fluid and returns into the oil reservoir 45.

Thereafter, the working fluid passes through the porous member 57. At that time, since the flow speed of the working fluid is reduced, the oil drops are separated from the working fluid in the porous member 57. The working fluid which passed through the porous member 57 flows into the right rotational motor-side space 47b, the working fluid generates turning flow by the influence of the rotation of the rotor 12, and a portion of the oil drops included in the working fluid attaches to the inner wall of the container 31 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 45.

The working fluid passes through the notches 39e and the gap 48 from the right rotational motor-side space 47b, and flows into the left space 49 which is a flowing place of the working

fluid between the rotational motor and the discharge pipe 44. The working fluid which flowed into the left space 49 generates turning flow by the influence of the rotation of the rotor 12 in the left rotational motor-side space 49a defined by the porous member 58. A portion of the oil drops included in the working fluid attaches to the inner wall of the container 31 by the centrifugal force of the turning flow or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 45.

Thereafter, the working fluid passes through the porous member 58. At that time, since the flow speed of the working fluid is reduced, the oil drops are separated from the working fluid in the porous member 58. The working fluid which passed through the porous member 58 flows into the left discharge pipe-side space 49b defined by the porous member 56 and where the working fluid is not influenced by the rotation of the rotor 12, and stays therein. While the working fluid stays in the left discharge pipe-side space 49b, a portion of the oil drops included in the working fluid attaches to the inner wall of the container 31 or falls due to the gravity and is separated from the working fluid and returns into the oil reservoir 45. Then, the working fluid is discharged from the discharge pipe 44.

With this above structure, the compressor of the sixth embodiment is the same as that of the fifth embodiment except in that the compression mechanism of the compressor of the fifth embodiment is changed from the rotary type to the scroll type and from the vertical type to the lateral type, and the porous plates 58a, 58b and 58c are fixed to the auxiliary bearing member 41. According to the scroll compressor of the sixth embodiment, the same effect as that of the fifth embodiment can be obtained and the oil separating efficiency can be enhanced.

The porous plates 57a, 57b, 57c, 58a, 58b and 58c are mounted on the bearing member 36 or the auxiliary bearing member 41 which are portions of the compression mechanism. With this,

the rotational motor used in the conventional compressor can be used as it is, and the compressor can be produced inexpensively.

Since the porous plates 57a, 57b, 57c, 58a, 58b and 58c are mounted on the projection 36b of the bearing member 36 or the projection 41a of the auxiliary bearing member 41, it is unnecessary to add a new supporting member such as a column, the porous plates 57a, 57b, 57c, 58a, 58b and 58c can be provided using a simple structure, and the compressor can be produced inexpensively.

Since the porous plates 57a, 57b, 57c, 58a, 58b and 58c are mounted on the ring grooves 36c, 36d, 36e, 41b, 41c and 41d provided on the outer periphery of the projection 36b 41a, the compressor can be assembled without using a fixing parts such as bolts, and the compressor can be produced inexpensively.

The effects of the embodiments can be obtained irrespective of kinds of the working fluid, but especially when carbon dioxide is used as the working fluid, remarkable effect can be obtained. That is, in the case of a refrigeration cycle using working fluid comprising carbon dioxide as main ingredient, since the working fluid discharged from the compression mechanism is brought into a supercritical state, an amount of refrigeration oil dissolved in the working fluid is increased, and oil separating effect in the container becomes more difficult. If such carbon dioxide is used in combination with the compressor of any of the first to sixth embodiments, it is possible to prevent the working fluid from being stirred and thus, the oil separating efficiency of the refrigeration oil can be enhanced. With this, it is possible to enhance the reliability of the compressor and the efficiency of the refrigeration cycle using the compressor, and there is a merit that the carbon dioxide as an environment-friendly refrigerant can be used as the working fluid.

Industrial Applicability

As described above, the present invention is applied to a compressor having lubricant oil, and is suitable as a compressor used for a refrigeration cycle such as a refrigerator-freezer, an air conditioner, a boiler and the like.